VOLUME XII NUMBER 5 AUGUST, 1948

The INSTITUTE Spokesman

Wheel Bearing Lubricant Tester CRC Designation L-24-745.

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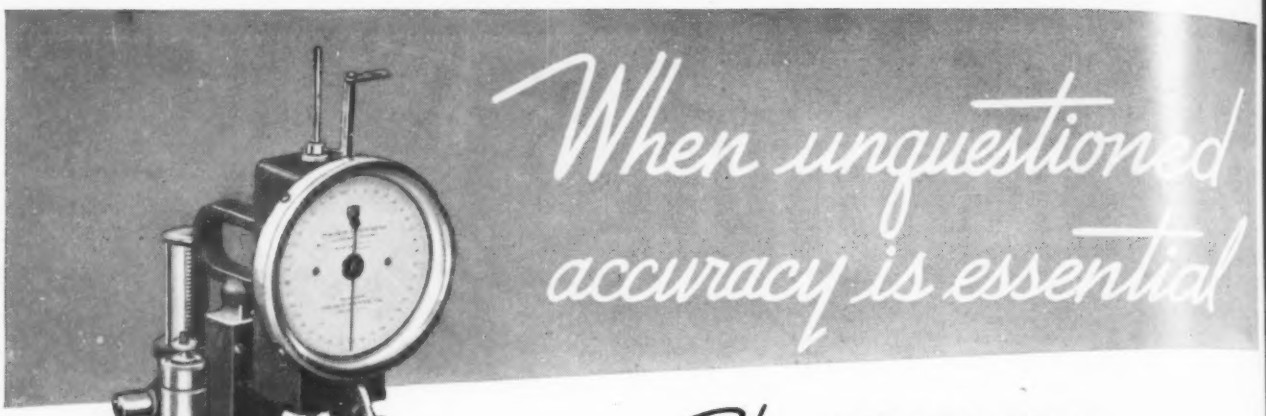

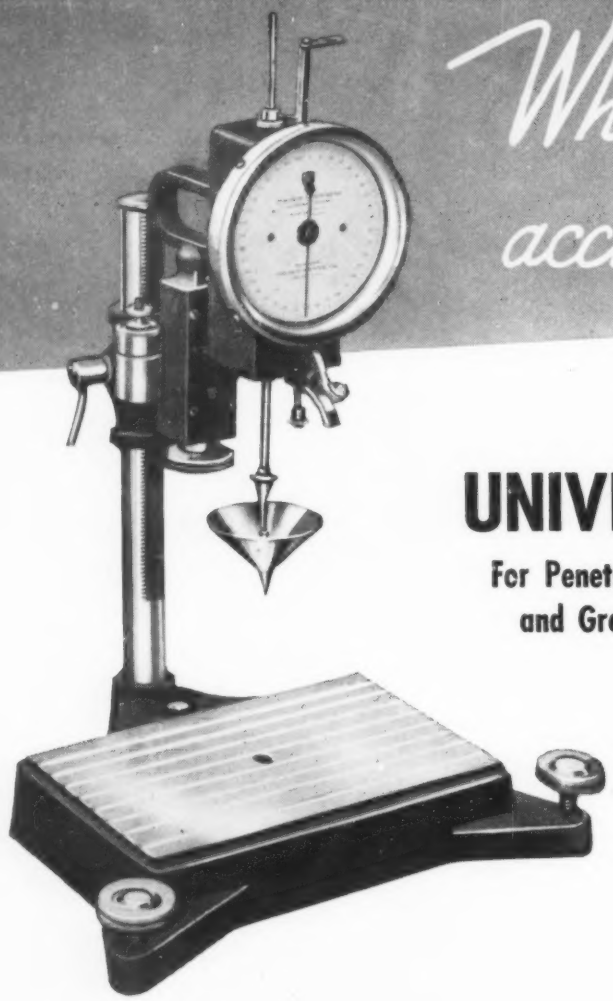

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ABOUT THE COVER . . .

**WHEEL BEARING LUBRICANT TESTER
ASTM DESIGNATION L-24-745**

This test may be used to evaluate the quality of wheel-bearing lubricants, so that their probable service behavior may be determined. The evaluation includes consideration of the following: (1) the tendency of the grease as such, or of the separated oil, to leak from the wheel-bearing in service. (2) ability of the hot grease to hold its form in the hub, (3) tendency of the grease towards abnormal consistency changes in plastic service, (4) tendency of grease to separate oil or soap in plastic service, (5) tendency of grease to fail to lubricate bearing, that is, to allow balls or rollers to run dry although adequate grease remains in the hub, (6) tendency of grease to form deposits upon the bearings or races.

The tester consists of a front wheel hub and spindle assembly, driven by a V-belt and motor, and encased in an insulated removable hood. The rear of the spindle is drilled so that a thermo-couple may be inserted. Two heaters, one continuous and one intermittent, are mounted on the base. The intermittent heater is controlled by a thermostat to maintain operating temperature, while the continuous heater is used for quick heat and is turned off when temperature is reached. A fan, mounted on the motor shaft, circulates air over heaters and hub. Instead of the regular grease retainer, a ring is used to catch any grease which leaks from the inner end of the hub. This ring is removable and makes grease loss easy to determine.

The test is run for six hours at a speed of from 430 to 450 R.P.M., with the temperature of the spindle at 220° F./2.5°.

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"HURL" YOUR RESERVATIONS IN FAST FOR THE ANNUAL MEETING OCT-11-13

NATIONAL SALES, INCORPORATED EXPANDS

Expansion of facilities and change of location to meet increasing business needs are announced by officials of National Sales, Inc., Wichita. A reorganization involving several changes in the concern's official staff is also announced.

Increased demand for the Gre-Zer-Ator, a one-hand grease gun sold exclusively on a national scale to oil and gasoline refiners and grease compounders, was cited as the reason for the expansion.

Number of Gre-Zer-Ators sold during the first year may exceed 75,000, company officials predicted.

National Sales, Inc., a manufacturers' representative for lubricating equipment and steel shipping containers, is now located at 812 North Main.

New officers are Oliver Elliott, vice president and general manager; and Howard F. Dearmore, secretary-treasurer and office manager. Elliott and Dearmore will handle active management of the concern.

Newly appointed eastern sales representative is Russell Head, who will headquarter in Chicago.

The steel shipping containers are sold by National Sales, Inc., in Kansas and Oklahoma.

Expansion and opening of new quarters brings offices, warehouse and service department under one roof, and company officials say the new location will result in better service for customers.

Elliott, a navy veteran, was formerly with Grit Printing company in Wichita. Dearmore, an army veteran, has been with National Sales since its inception nearly a year ago. Other officers are H. A. Mayor, Sr., president; Charles Slawson, assistant treasurer; and H. A. Mayor, Jr., member of the board of directors.

The INSTITUTE SPOKESMAN

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THE NATIONAL LUBRICATING GREASE INSTITUTE

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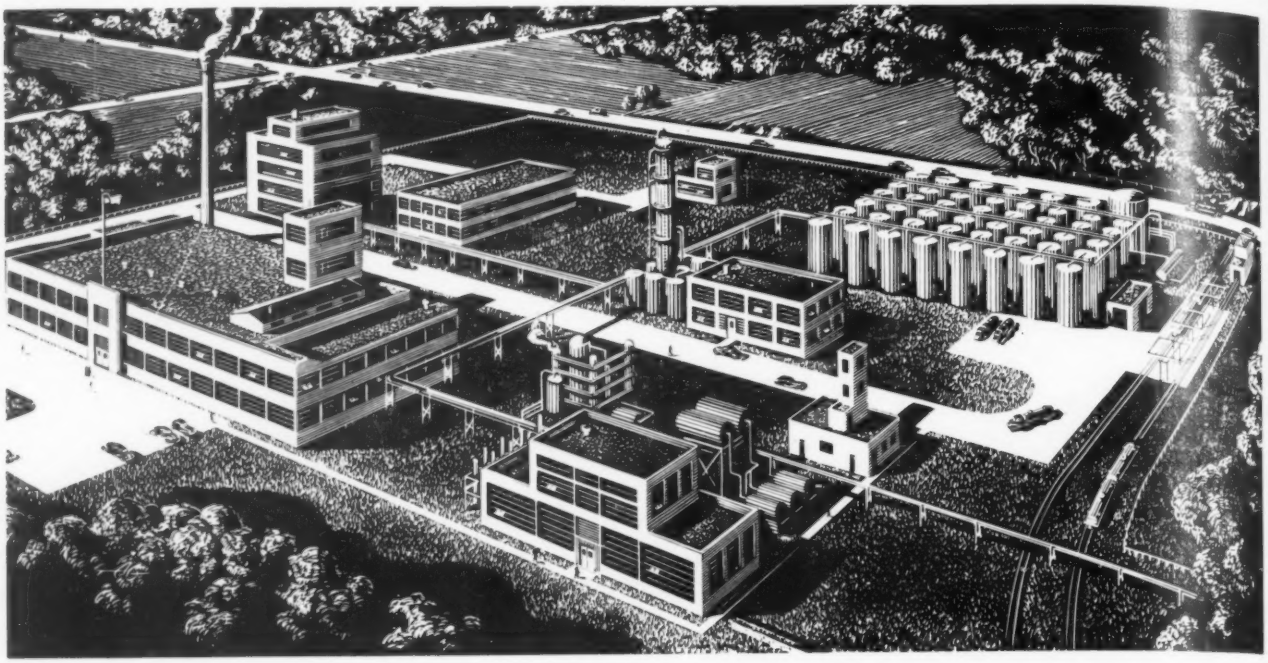
News Release . . .

W. C. Bryant Becomes Chief Research Chemist for Swan-Finch

C. E. Hartwig, Director of Research for Swan-Finch Oil Corporation has announced the promotion of W. C. Bryant to the position of Chief Research Chemist. For the past two years Mr. Bryant has been a group leader in the Research Department. Previously, he had spent eight years in the production division as a control and chief chemist.



FATS AND FATTY ACIDS IN LUBRICATING GREASES

Swift & Company Gives Preview Of New Technical Products Plant

Construction of a new Industrial Oils processing plant at Hammond, Indiana will add new sources of glycerides and fatty acids to the Industrial oil production of Swift & Company. This new construction will include units to carry out three processes, namely: solvent crystalization, solvent fractionation, and fat splitting. These processes will be combined with present facilities for refining, bleaching and hydrogenating to obtain a wide scope of industrial oil products suitable for uses in a multitude of industries.

By these processes, integrally operated for the first time in this plant, Swift & Company can assure grease manufacturers of a supply of new and improved industrial oils of uniformity in quality and in quantities sufficient to fill the requirements of the industry. At the same time the company can more fully utilize the raw materials available as by-products from its many plants.

The manufacture of greases has exhibited remarkable development since the time when simple mixtures of lime soaps and petroleum oils were compounded for greasing axles on carts and wagons. Today, by formulation and specific processes hundreds of special greases have been produced to meet particular requirements of color, gloss, texture, stability, and consistency under widely varying working conditions. Scientifically controlled procedures have replaced trial and error methods.

While mineral oil content is very important in the proper formulation of a grease, considerable attention has been specifically directed toward the soap stocks used as a determinant of such properties as texture, length of fibre, consistency, etc. To this end manufacturers have used a variety of fatty materials.

High speeds, higher bearing pressures, new metallic compositions in bearings, and closer bearing tolerances all have added to the current lubrication problems in both automotive and industrial applications. Stability to oxidation, objectionable gumming and evaporation of moisture are items which must be controlled as well as film strength and oiliness. While Swift & Company has been supplying the trade with fatty oils for many years, the new installation at Hammond will enable them to furnish material of high quality and also of high uniformity. For example, the lubricating grease industry has long desired a glyceride combining both a fairly high free fatty acid with a light color. Until now, high acid has always been accompanied by an objectionable dark color. However, with the advent of Swift's propane decolorizing unit dark glycerides can be processed to yield the desired product. This with improvements in such important properties as stability in color, percent unsaponifiable matter, and melting point it will go far in helping to solve the problems of the

dustry.

Research into new and improved products and new applications for these products will be a vital part of the new operation and will be carried on in a pilot plant unit and in Swift & Company's research laboratory facilities.

The present production of industrial oils by Swift & Company is obtained almost entirely from glycerides of animal origin. However, the new Hammond plant will also allow volume production of glycerides and fatty acids from vegetable and marine oils.

The fat splitting unit in the new plant is a Colgate-Emery continuous hydrolysis unit and is being constructed by the Blaw-Knox Company. (See Figure 1.) This process is a continuous high temperature hydrolysis employing countercurrent reaction in a pressure tower with internal heat exchange. In this unit, the fat is introduced into the splitting column at the bottom and water at the top. These two materials react countercurrently in the column at about 500°F. and 725 pounds per square inch pressure. Heat exchange between fatty acid and water takes place in the top portion of the column and between fat and sweetwater in the lower portion. An almost instantaneous splitting takes place and the reaction products, the fatty acids and a small quantity of water from the top of the column and the glycerine sweet water from the bottom, are continuously removed. The heat required to maintain the contents of the column at operating temperature is supplied by direct high pressure steam. Of special significance is the fact that this method produces more active fatty acids because of the very high percent split obtained. With tallow fatty acids, for example, the product contains more than 98 percent free fatty acids.

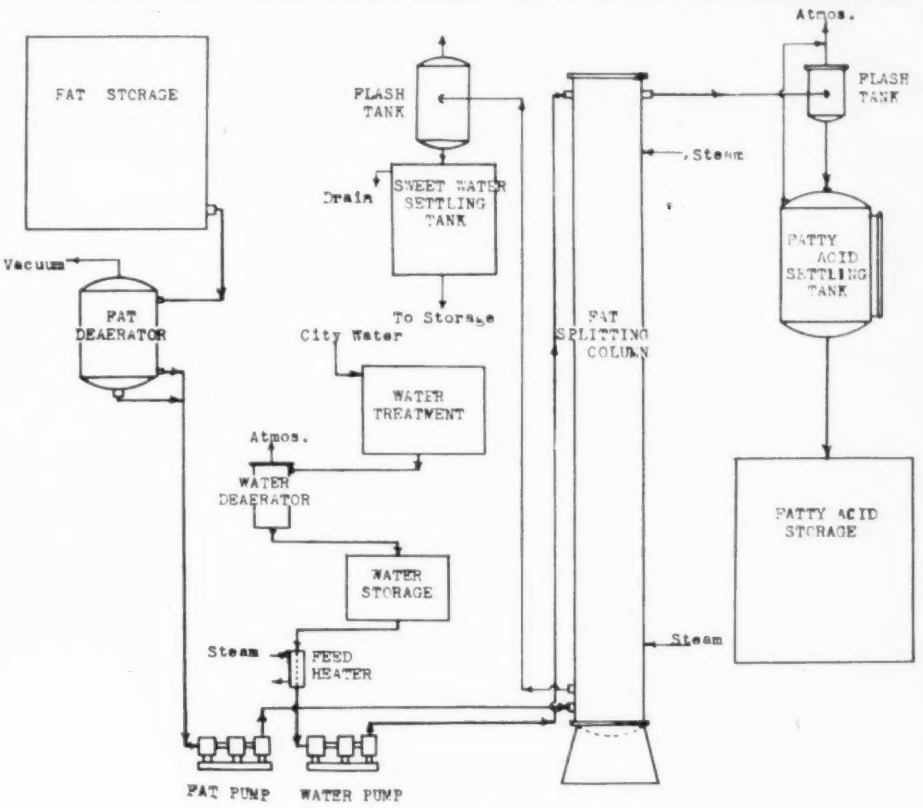


Figure 1. *Fat Splitting Unit*

TABLE I

Product	*Free Fatty Acid*	*Titer*	*Color NPA*	*Color FAC*
Decolorized Tallow	10-15%	38-44°C	2½-3	7-9
Decolorized Tallow Fatty Acid	97+%	38-44°C	2½-3	7-9
Hydrogenated Tallow	4- 6%	58-59°C	2½-3	7-9
Hydrogenated Tallow Fatty Acid	97+%	58-59°C	2½-3	7-9
Hydrogenated Marine Oil	4- 6%	45-46°C and 51-53°C	2½-3	7-9
Hydrogenated Marine Oil Fatty Acid	97+%	45-46°C and 51-53°C	2½-3	7-9
Decolorized Vegetable Fatty Acids		Standard grades		
Hydrogenated Vegetable Fatty Acids		Standard grades		
Stearic Acid		Standard grades		
Red Oil		Standard grades		
Lard Oil		Standard grades		
Sperm Oil		Standard grades		

The above specifications are average and can be varied to meet specific requirements of individual grease manufacturers.

The fatty acids produced are light colored due to the brief reaction time and the absence of the effect of harsh catalysts. In addition the water entering the system is completely deaerated and softened to give increased purity and prevent any darkening through oxidation. The percentage of split obtained is high and the unsaponifiable matter is kept at a minimum. Thus Swift will produce mixed and fractionated fatty acids of high quality now in demand by manufacturers of all types of greases as well as for other products such as synthetic rubber, plastics, synthetic resins, printing inks, soaps, cosmetics, and numerous others. The glycerine from the sweet water will be used in products such as cellophane, flexible glue, printing rollers, etc.

The solvent fractionation process at Hammond is to be carried out in a unit being built by the M. W. Kellogg Company employing their Solexol process recently introduced into the glyceride oil industry. (see Figure 2). The Solexol process employs propane as a solvent and operates at pressures sufficient to maintain the propane in a liquid state and at temperatures below

(*Continued on page 6*)

FATS AND FATTY ACIDS

(*Continued from page 5*)

206°F. The process is a continuous liquid-liquid extraction whereby the liquid propane and fatty material are passed countercurrently through a column with the temperature and pressure so controlled that a portion of the raw material is selectively taken up by the solvent and removed from the top of the column. The remainder of the feed stock, being insoluble, is removed from the bottom of the column among with small amounts of solvent. The overhead and bottom products are continually removed and stripped free of all solvent.

Decolorization or solvent bleaching is a specific example of solvent fractionation for which Solexol is extremely well adapted. For decolorization the temperature and pressure are so regulated that only a small portion of the feed stock is insoluble in the solvent. The removal of this portion, consisting primarily of color bodies, bleaches the glycerides or fatty acids which are taken up by the propane. This process will remove color bodies that normal refining and bleaching will not remove and with a lower loss of product than that usually encountered by standard bleaching practice. Thus by decolorization, the quality of many products can be improved.

By the other varied fractionations which can be carried out, drying oils, vitamin concentrates, and relatively pure fatty fractions of high quality can be produced for use in a wide variety of industries.

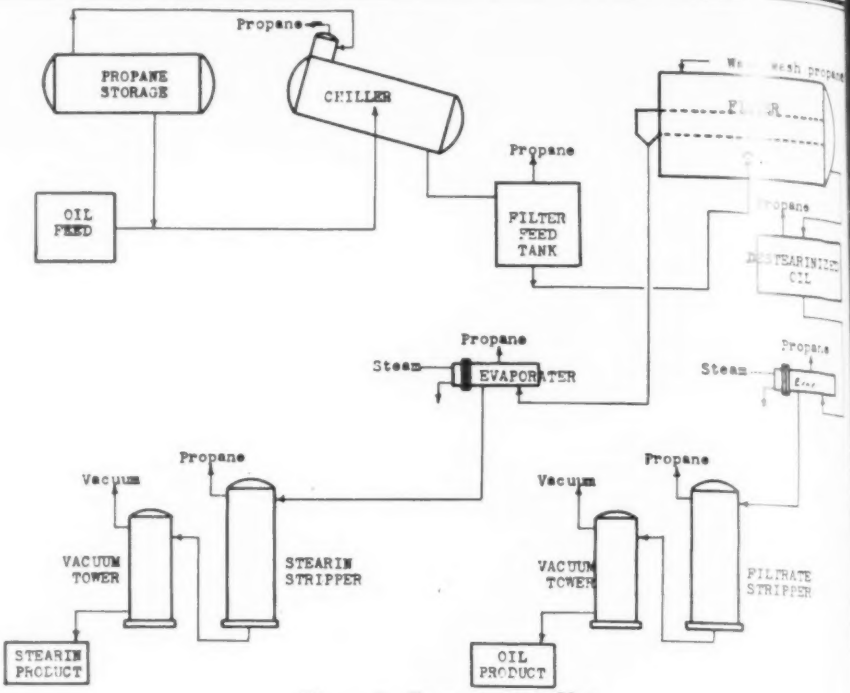


Figure 3. *Destearinizing Unit*

The third process, solvent crystalization or destearinization, will be carried out in a unit also being constructed by the M. W. Kellogg Company (See Figure 3). Solvent crystalization is a process for low temperature fractionation of fatty materials. In the unit being installed, the feed stock is taken up with propane and the solution is then chilled until the higher melting fraction is crystalized. The slurry of crystalized fatty material and liquid propane and oil is then fed to a continuous filter where the fatty crystals are removed and the liquid and solid fractions are removed from the filter and stripped free of solvent.

By this process lard oil and stearine, red oil and stearic acid, and

(*Continued on page 29*)

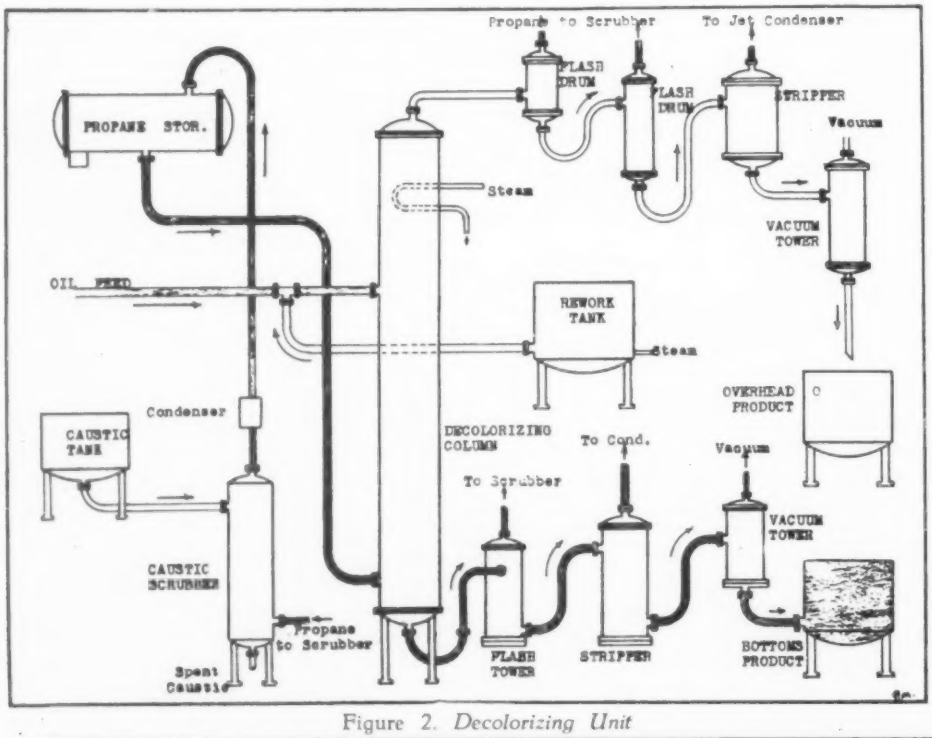
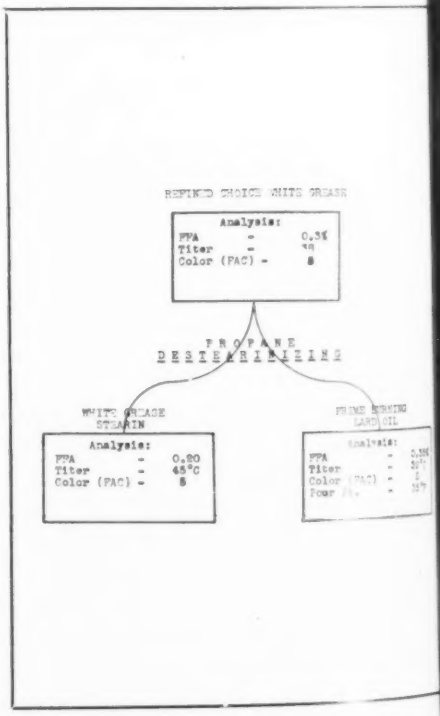


Figure 2. *Decolorizing Unit*



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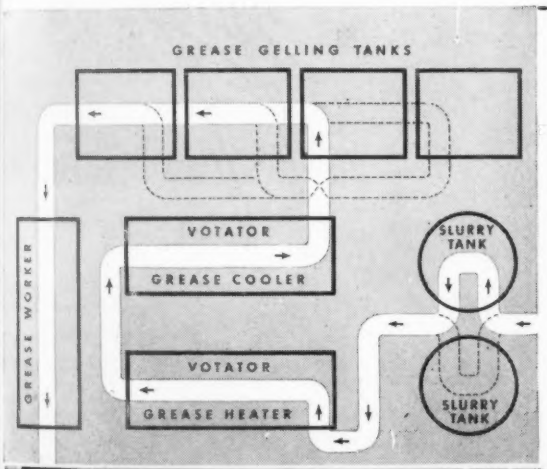

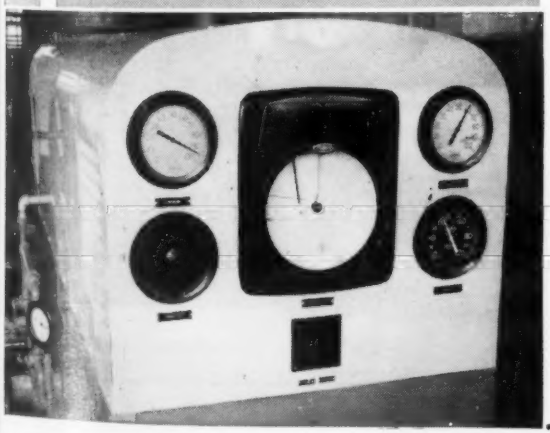

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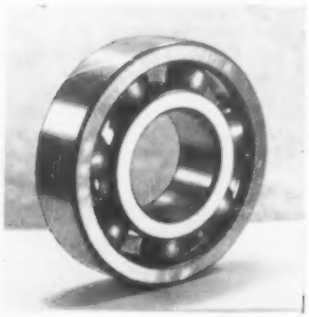

Friction Oxidation..

by

Hudson T. Morton, Standards Engineer

and

Francis G. Patterson, Research Engineer

THE FAFNIR BEARING COMPANY

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During the late twenties and early thirties, motorists in California and the Western States replaced many anti-friction bearings in the wheels of their automobiles without complaint. Later, these bearings were returned to the automobile manufacturers for examination, as many of the cars were driven only a few miles before failure was noticed. Investigation by J. O. Almen[1], of General Motors Corporation and D. A. Wallace[2], of Chrysler Corporation disclosed that these bearing failures occurred during transportation of the new automobiles in freight cars where the weight of the autos rested on the wheels. Theoretically, the auto was braced in the freight car to prevent its movement. Actually, the automobile vibrated from motion of the freight car, and moved as far as the end play in the wheel bearings would permit, while the wheels were securely braced in the car. This vibration was sufficient to cause the balls and rollers of the bearings to imbed themselves in the races. This failure was called "false brinelling" as shown in Figures 1 and 2.

Simultaneously with the automotive problems, textile customers reported early failures of bearings subjected to vibratory conditions and oscillating motion of small amplitude. A laboratory research program was begun to duplicate these operating conditions and determine the cause of failures.

This same type of bearing failure occurred in K4N aircraft control pulley bearings where the outer race oscillates back and forth through a small arc instead of making com-

About the Authors . . .

Hudson T. Morton was born on January 29, 1902 in Ann Arbor, Michigan.

In 1924 he received his B. S. degree in Chemical Engineering from the University of Michigan. After graduation Mr. Morton was employed for 21 years as a Metallurgist and Sales Engineer with the Hoover Ball & Bearing Company. His next step was to the Precision Parts Company as a Consulting Engineer. For the past two years he has been employed by the Fafnir Bearing Company as a Standards Engineer.

Mr. Morton has written articles on Metallurgy, Anti-Friction Bearings and Lubrication. He is a member of SAE, ASM, Army Ordnance Association, and the Engineering Socity of Detroit; and is active on ABEC and ASA sub-committees.

Hudson T. Morton

Francis G. Patterson was born on November 15, 1911, in Richfield Springs, New York.

In 1932 he received his M. E. degree from the Rensselaer Polytechnic Institute. For the past 12 years he has been with the Fafnir Bearing Company as a Research Engineer. Before this he worked as an Engineer for the Mohawk Limestone Products Company; and later joined the production equipment research staff at ANSCO Film Division of General Aniline & Film Corporation.

Mr. Patterson is a member of Sigma Xi, an honorary research society.

Francis G. Patterson

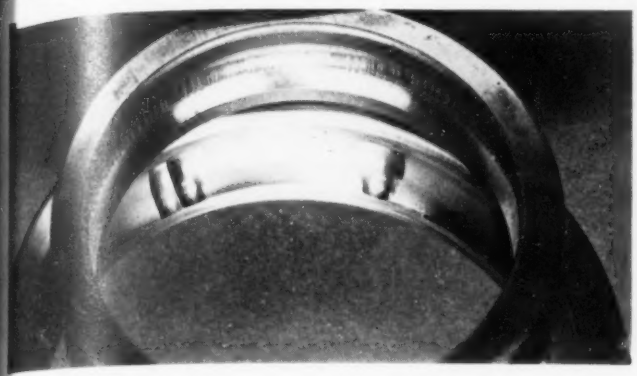

Figure 1. *Typical failure of annular bearing outer race by friction oxidation of "false Brinelling".*

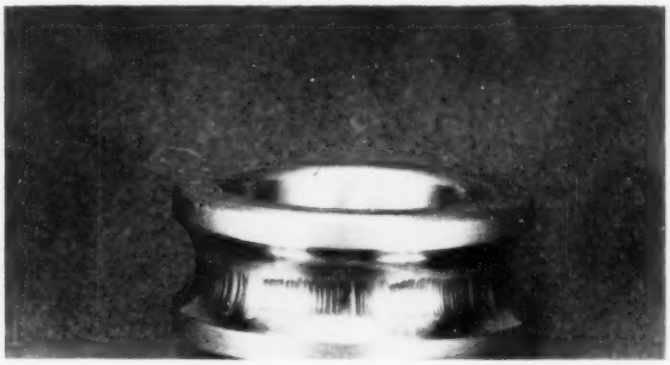

Figure 2. *Typical failure of annular bearing inner race by friction oxidation or "false Brinelling".*

plete revolutions. (Figure 4) Both races and balls show wear and deep holes very similar in appearance to "Brinell" holes caused by overloading. (See Figure 3) Electric motors and other equipment transported across country with shafts or rotating parts insufficiently secured to prevent vibration have developed similar failure. Oscillating bearing applications also "Brinell" or "Oxidize". The main thrust bearings of variable-pitch airplane propellers and helicopters show similar identation.

Bearing damage of this type has occurred in many anti-friction bearings that are normally at rest and oscillate through small angles in applications; such as, automobile spring shackles, king pins, aircraft rocker arms, variable pitch propellers, landing wheels, transported machinery and motors, textile cam followers, etc.

This type of failure can be recognized because the balls or rollers have slight flats on them at the areas of contact and both races show discoloration or holes at the contact areas depending upon how advanced the failures are. Advanced failures have noticeable holes as shown in Figures 1 and 2. Early stages show only discoloration but no holes as in Figure 5.

G. A. Tomlinson[4], conducted experiments by rubbing balls against steel plates and obtained similar "wear"—patterns which he theorized as being caused by "welding" of the surface layers of the metal. Dr. M. Fink[5], rubbed the O.D. of 40 m m diam. discs together and wore off their surfaces reducing their weight 0.1802 grams after 50,000 revolutions in air, but no loss in weight in a nitrogen atmosphere. He attributed this phenomenon to oxidation, but other investigators[6] disagreed in the rate and cause of wear.

Both Mr. J. O. Almen[1] and D. A. Wallace[2] experimented to determine the cause of these bearing failures and summed up their results by stating that the rapidity of failure was decreased by the smoothness of the contact surfaces and the ability of the lubricant to prevent oxygen from being present at the contact surfaces.

In 1939, a surprise came when bearings with "unground" races lubricated with certain new greases outlasted the best quality precision bearings packed with conventional good ball bearing grease. These new greases contained lithium soaps and were developed especially for low temperature applications.

This phenomenon acted as an impetus in speeding up the Fafnir laboratory research program. Figure 6 illustrates the test machine developed to oscillate the outer ring of an anti-friction bearing. The angle of oscillation and combination of radial and thrust loads could be varied to suit service operating conditions for the bearing being tested. With this machine engineering features of race contour, surface finish, seals, lubrication, load and speed could be varied to determine their effects.

Figure 3. *Annular bearing inner race "Brinelled" by excessive loads pressing balls into it.*

These tests indicate the following factors affect the results:

Detrimental:

Small angles of reversal where ellipses of contact overlap during movement as shown in Figure 7.

Heavy loads, exceeding 35 to 50% of catalog loads.

High viscosity and thick lubricants.

Poor oxidation resistance of lubricant.

Deterioration of grease to form acids.

Presence of extra air at contact areas.

Advantageous:

Large angle of reversal where balls rotate 180°, See Figures 7 and Chart 1.

Light loads of less than 35% catalog.

Low viscosity fluid lubricants.

Lubricants with strong adhesive properties.

Lubricants with high resistance to oxidation and deterioration.

Machine design to keep bearing submerged in lubricant and prevent access of air to ball and race surfaces.

Grease with extreme pressure characteristics combined with previous properties.

Theory:

The theory of failure can be summed up as follows: The load squeezes the lubricant from the contact areas of balls with races and compresses their surfaces to increase the area of contact as shown in figure 8. Normal rotation pushes extra lubricant ahead of the balls.

(*Continued on page 10*)

FRICTION OXIDATION

(Continued from page 9)

Simultaneously positions A and C on the inner race move with greater surface speeds than position E because of the difference between R and R_1 from the bearing axis. Likewise positions A and C on the ball move more slowly than position E because of their shorter radius r_1 than r to the ball axis. If we assume position E on the ball and on the race travel at the same surface speed because they are in intimate contact then skidding occurs at positions A and C. Thus frictional heat is generated at A and C.

Reversing action momentarily causes skidding at E while rotation creates friction at A and C. This action moves the balls into the area free from lubricant with resultant metal to metal contact, "welding", skidding, heat, and oxidation of grease. The air present oxidizes the heated metal surfaces. If the decomposition of the grease forms acids, these increase the rapidity of oxidation as shown particularly in figure 9. At this stage, only dark smears appear at the contact areas of the balls and races. Continued operation mixes the iron oxide surface film with the lubricant forming a good lapping compound (rouge) which reduces the sizes of the balls and races. Advanced failure leaves deep holes in the races.

Thus the true name for this type of failure is FRICTION OXIDATION.

When no rotation occurs but the balls or rollers are alternately pressed into the races and released the resulting failure can be called "False Brinelling".

When bearing inner rings are slightly loose on the shaft or outer rings are slightly loose in the housings momentary movement occurs as the balls or rollers carry their loads. This movement creates frictional heat with resultant formation of iron oxide. This condition leaves an irregular oxide pattern on the external bearing surfaces which is generally called "Fretting Corrosion".

Referring to Figure 8 when the balls rotate through an angle of 180° as in A, lubricant will be carried from the first race to the second and vice versa. As the motion decreases to positions B and C lubricant will not be carried from one race to the other. Instead the lubricant is squeezed from the ball path which is left relatively bare. When the oscillation is as short as shown in E, F, and G the actual ellipse of contact at the start and completion of rotation overlap. Thus no fresh lubricant is brought to the race and the rate of friction oxidation is very rapid.

Lithium soap greases and some fluid extreme-pressure lubricants appear to have sufficient adhesiveness to wet the race surfaces and decrease oxidation. By keeping all contact surfaces submerged in lubricant and air touches them and the life is increased. Fluid lubricants give better results than channeling greases.

Grease Evaluation:

To evaluate lubricants, the test machine shown in Figures 10 and 11 was developed by The Fafnir Bearing Company. Briefly, the apparatus consists of a base supporting a vertical stationary shaft on which a collar containing No. 4305S ball thrust bearing washers is oscillated by means of a connecting rod operated by an electric motor. A load is imposed on the balls and washers by means of a calibrated spring

(Continued on page 13)

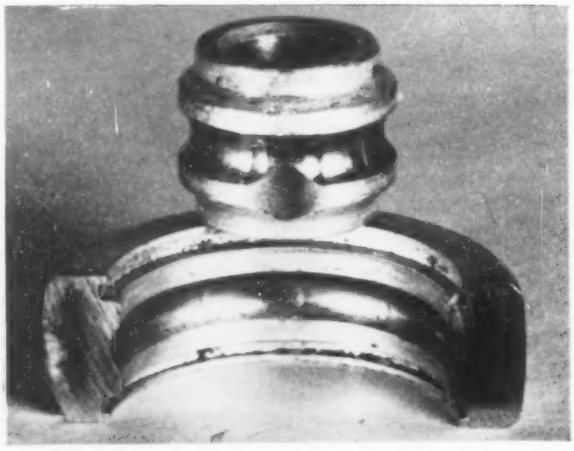

Figure 4. *Effects of Friction Oxidation on inner and outer rings of aircraft control bearings. These bearings are used in pulley controls which operate only with an intermittent, oscillatory motion through a small amplitude.*

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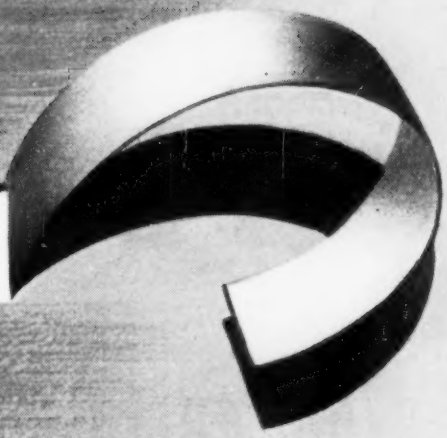

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Technical Committee Column

CHAIRMAN T. G. ROEHNER, "DIRECTOR OF THE TECHNICAL SERVICE DEPARTMENT, SOCONY-VACUUM LABORATORIES."

- TIME SPECIFICATIONS
- LIBERAL RANGES
- FROM "DOLLARS PER TON" TO "CENTS PER POUND"
- CHICAGO MEETING

In the June issue of this column mention was made of a survey to obtain the reaction of the Technical Committee to the ASTM Committee C-7, Subcommittee III, proposal for a specification for lime for use in the manufacture of greases. The eighteen replies received may be summarized to the effect that the ranges suggested were more liberal than those in actual use by the NGLI membership. This consensus was relayed to Mr. R. W. McAllister, Chairman of the aforementioned ASTM Subcommittee, by Messrs. H. E. Achilles and John Musselman who attended the ASTM meeting in Detroit on June 22nd as representatives of the NLGI Technical Committee. After extensive discussion by Subcommittee III, the following was proposed for further criticism and comment by lime manufacturers and consumers.

Available CaO, %	70 min.
MgO, %	1.5 max.
SiO_2, %	1.0 max.
Fe_2O_3 (Iron as), %	0.5 max.
Particle Size	
through 200 mesh	98 min.
through 325 mesh	95 min.

We plan to conduct another survey to ascertain the Technical Committee's viewpoint regarding the above.

It has been pointed out by the subject ASTM group that lime hydrate can only be as pure as the

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limestone rock from which it is produced. No substantial reduction in the concentration of impurities can be effected without the use of processing operations which would take lime hydrate out of the "dollars per ton" classification into the "many cents per pound" type of chemical. In other words, the present procedure of manufacture, wherein the natural limestone as removed from the ground is calcined or burned to quicklime, which in turn is converted to lime hydrate, results in no marked change in the percentage of impurities. It follows that each step in narrowing the limits of percentages of impurities permitted by specification has an important effect on the number of lime manufacturers who would be in a position to meet the more restricted ranges. It will be recognized that it is well worth while to give this specification careful consideration. Comments by members of the Technical Committee regarding the above proposal should be forwarded to Messrs. W. H. Oldacre, H. L. Moir, or T. G. Roehner.

WE HOPE THAT THE MEMBERS OF THE TECHNICAL COMMITTEE WILL KEEP IN MIND THE MEETING IN CHICAGO, OCTOBER 11-13, 1948, AND WE EXPECT TO RECEIVE SUGGESTIONS SOON REGARDING SUBJECTS TO BE PLACED ON THE AGENDA.

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SHORTAGES, OR UNPRECEDENTED DEMAND?

by H. P. Hobart, Vice President, Gulf Oil Corp.

There is real need at this time that present management present to the public the full story of the record of the Petroleum Industry in providing Petroleum Products to meet the public demand.

Over a period of less than ninety years since the Drake Well was drilled in Western Pennsylvania in 1859, the industry has grown under our capitalistic system of free enterprise, practically without Government aid or subsidy, from a very humble beginning to the fourth largest industry in this country, directly employing 650,000 people and contributing to the transportation, convenience, well-being and pleasure of more than 50 million men and women.

This is a truly remarkable record, which offers ample testimony of the courageous, progressive, and alert management which the Petroleum Industry has enjoyed through this period under our free enterprise system. Nowhere else in the world can one point to such an outstanding record of progress and service to the public.

Over these years management has been confronted with many difficult problems. It is indeed fortunate that the first wells in Pennsylvania were in shallow fields and that markets were nearby.

The industry has been constantly called upon to develop new and more efficient ways of locating the pools of oil hidden under ground. The depth of wells has increased from 300 or 400 feet to as much as 16,000 feet. New drilling tools and equipment and new refining methods had to be developed. Pipelines, tank cars, tank ships, tank trucks, had to be improved upon to proyide adequate transportation. Oil producers have not only transversed the United States, but they have gone to the four corners of the earth in their search for oil, and today oil is produced in commercial quantities in 40 countries of the world.

The continued development and improvement of products has been no less amazing. New products have been developed to meet the various needs to match progress in transportation and manufacture.

Two world wars have been fought and won by those having an unfailing supply of petroleum products.

Nor has the Petroleum Industry, while unhampered by Government control, failed to amply provide petroleum products for the needs of all the people of the United States. Proponents of our free economy can point with pride to this outstanding record.

Only during the period of Government controls, during World War II when steel and many other materials were so tightly rationed, and also as a result of that war, has the Petroleum Industry failed to provide the constant expansion necessary to meet the continuously growing needs of the American public for petroleum products.

Everyone knows how thoroughly plant extensions were curtailed during the four years of the war and how production and refining capacity was held back in relation to demand. In spite of these obvious facts, during the last nine months several Congressional committees, many newspapers and many public speakers, have placed blame on the Petroleum Industry for so-called shortages in petroleum products since the war.

There has been so much of this unjust critisism that the Petroleum Industry has been pushed into a defensive position, which is entirely unfair in view of the record.

But the Petroleum Industry has not yet adequately presented its story to the public. The danger of not doing so lies primarily in the direction of additional agitation toward some form of Government control of the industry. While Government control might establish some form of rationing of such quantities of petroleum products as are available, it is difficult to see how Government control would make any greater quantities of oil available than could be produced from the present crude supply with the present manufacturing, transportation and marketing facilities. On the other hand, Government control would probably slow up processes already instituted by the industry under its present private management and would, therefore, in the long run, undoubtedly prove a detriment to rather than a help to the post war problem of providing as promptly as possible sufficient petroleum products to meet all demands.

For some reason or other the public has long evidenced a sort of proprietary interest in the oil business. This is perhaps a somewhat natural result of the way crude oil production has been developed in this country, because of the many farms and areas participating through-out the 25 producing States.

Many politicians recognize this situation and attempt to make political capital out of using the oil industry as a political football and by agitating one form or another of Government control. To make such ideas attractive they must claim that oil properties could be better and more efficiently managed under Government control and that, as a result thereof, the public would secure better products and better service at lower prices. Such claims have no historical support, and I doubt if anyone who, while taking a fair-minded view of the subject, feels that Government operation of the petroleum business would bring any of these betterments. Based upon experience to date the opposite would be expected.

Because of this, however, it behooves the petroleum industry to handle its public relations in such a way as to build public confidence and respect for the present type of producing, refining, transportation and marketing operations.

We know that during the 4-year period of the war normal growth of pipelines, refining, marine and rail transportation, and marketing facilities, were curtailed because of inability to secure steel and other supplies under Government rationing. The so-called shortages, therefore, which we have recently experienced are a direct result of the war plus the present unprecedented demands.

(Continued on page 16)

SHORTAGES, OR UNPRECEDENTED DEMAND

(Continued from page 15)

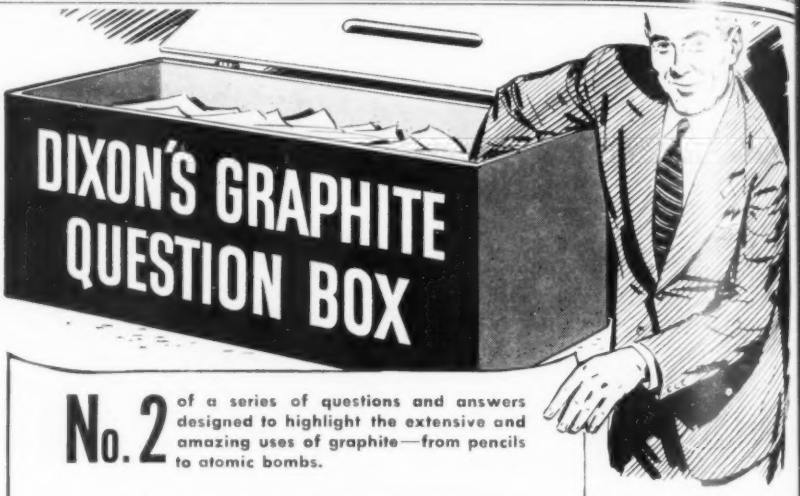
Blame should not be attached to the petroleum industry for these shortages which resulted directly from Government regulation. Nor should the petroleum industry be blamed for lack of foresight, as the record shows that the industry never previously failed to provide adequate products as long as they were unhampered by Government control.

In the hope of striking a sympathetic note with the public, some politicians have criticised price increases within the last six months on petroleum products. Many of these critics do not take the trouble to explain that these price increases on petroleum products largely reflect price increases on raw materials such as crude oil, labor and supplies. That a large portion of the crude produced in the United States is produced by independent producers who are not refiners and who are interested only in producing and selling crude, and that under such conditions the current price of crude must necessarily reflect the current cost of prospecting, drilling supplies, pipe, labor and other items which go into the cost of producing the crude. Necessarily, therefore, the price of crude must be adequate to cover the cost of production if these operators are to remain in business.

On the other hand, there are many small refiners who produce no crude of their own and who are entirely dependent on purchased crude. Their prices for products in a competitive market must be adequate to cover the cost of crude plus the cost of their refining operations if these refiners are to remain in business. This should be clear to anyone who has any knowledge of the fundamental principles of business.

Gasoline (ex tax) today is one of the few products that is selling below its price in 1919. A large portion of the retail gasoline price today consists of the State and Federal taxes. The first gasoline tax was introduced in the State of Oregon in February 1919 at 1c per gallon. Today State and Federal taxes on gasoline sold in the United States amounts to approximately $1,655,068,120.00 per year. The State gasoline tax alone grew from one million dollars in 1919 to over one billion dollars in 1947.

(Continued on page 17)



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QUES. What are the principal characteristics of graphite?

ANS. Extremely unctuous. Lustrous and opaque. Withstands excessively high and low temperatures. Fusibility unknown but probably about 3000° C. Combustible in the presence of oxygen at about 620° C., but not altered by heating in a vessel free from air. Chemically inert. Good electrical and heat conductivity. Low co-efficient of expansion. Non-magnetic, non-fusible, non-toxic, non-odorous, and does not permanently stain. Specific gravity: 2.1 to 2.3. Moh's scale of hardness: less than 1.

QUES. What are *some* of the products or processes in or on which graphite is used?

ANS. Tungsten and molybdenum wire filaments
Steam and internal combustion engine cylinder lubricants
Hydraulic pump piston and piston rod lubricants
Extreme heat-and-pressure-resisting lubricants
Mechanical packings and gaskets, washers and sealing rings
Pipe joint compounds and seals
Brake linings
Paper (lubricating and transfer)
Typesetting machine mold, space band and mouthpiece lubricant
Wire drawing
Oil-less, self-lubricating bearings
Transmission chain lubricant
Transmission rope and cordage lubricants
Trolley wire lubricants
Protective surface coatings with lubricating qualities
Impregnated lubricating metals, plastics, rubber, felt, fabrics, leather, paper and wood
Lubricating bearing paste
Mechanical oven, lehr and kiln chain lubricants
Metal stamping, forging, tumbling and assembling lubricants
Lathe dead center and steady rest lubricant
Rolling mill lubricants
Quarry and mine machinery lubricants
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(To be continued in No. 3)

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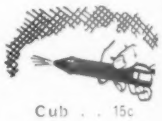

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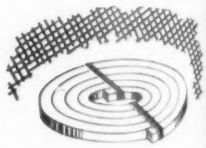

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Gasoline is purchased today largely as a convenience item through several hundred thousand conveniently located gasoline service stations in the United States. If one deducts State and Federal taxes from the gasoline price today at service stations and compares these prices with those existing in 1919, one cannot help but stand in amazement and admiration of the fine record which the petroleum industry has made over the last thirty years in providing better products at lower prices to the American public. The posted service station price of motor gasoline in fifty representative cities in the United States in 1919 was in the order of 25.41c per gallon without tax, and compare today (7-1-48) with approximately 19.56c per gallon, ex tax, for house brand gasoline. Thus today's price, except for the tax, is approximately 5.85c per gallon lower or about 23%. How many other products today will show such a comparison? Yet this is the record of the industry which has been so widely criticized and politically threatened with Government controls.

Published financial statements for many of the oil companies for the year 1947 and for this year to date have shown record profits. With the larger companies this results primarily from the liquidation of crude reserves, developed at the comparatively low costs existing prior to 1942, at today's high price for crude which, as previously stated, must necessarily reflect current costs of finding and producing crude.

For many years prior to the last war most of the oil companies were able to provide for yearly expansion out of that portion of profits not paid out in dividends, plus depletion and depreciation reserves. Today, with new plant and equipment costing 1½ to 3 times pre-war costs, many companies are unable to meet their demands for capital for additional plant facilities out of earnings plus depletion and depreciation reserves, and have been forced to secure additional outside capital. The economics of putting such additional new capital into new construction at 1½ to 3 times pre-war cost is a definite worry to management, yet they are faced at this time with an unprecedented demand for products which cannot be satisfied without making up, even at today's high prices, for some of the normal expansion which management was required to forego during the 4-year war period.

During the war period, with prices of products frozen by O. P. A., with high corporation taxes, and with the excess profits tax to drain off such profits should the earnings of an exceptional company get up that high, there was little possibility of setting aside reserves to take care of, at some later date, normal plant expansion necessarily postponed during the war.

Federal income tax regulations still base depletion and depreciation rates upon actual cost, although replacement of worn-out facilities currently may cost 2 or 3 times the amount of depreciation reserve accumulated for a fully depreciated piece of equipment. This condition is gradually drying up considerable working capital throughout business, and it has long been apparent that Government allowance for depreciation should be liberalized and that income tax regulations should permit

(Continued on page 22)

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FRICTION OXIDATION

(Continued from page 10)

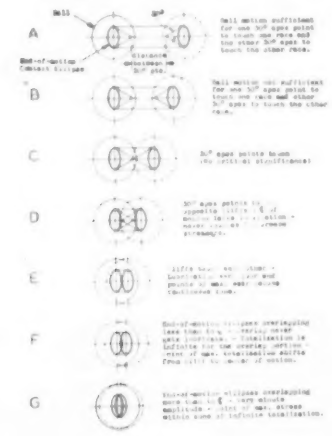

Figure 7. *Diagram of the ellipses of ball contact with the races. Where the ellipses touch one another or overlap (EFG), the races remain dry, free from lubricant, and failure occurs most rapidly. In (A), balls move far enough to carry lubricant from first position to second position and back.*

held in compression by threaded collars screwed onto the vertical shaft. Before assembly, the washers and retainer assembly are carefully cleaned and accurately weighed and a sample of the test grease is applied to them.

The machine is set in motion so the washers are oscillated for 50 hours. They are then disassembled and again cleaned and weighed. The difference between the initial and the final weights indicates the amount of wear which is the index of the lubricating quality and/or friction oxidation resistance of the grease. A new set of thrust bearings is used with each test.

Figure 5 shows a group of thrust bearings arranged in order of increasing friction oxidation of the greases tested. Acceptable greases are those whose average wear is less than .002 grams.

In general, greases which meet this test procedure are satisfactory in the test machine shown in Figure 6, and in service. Thus greases which do not meet this test are not recommended for oscillating conditions.

(Continued on page 23)

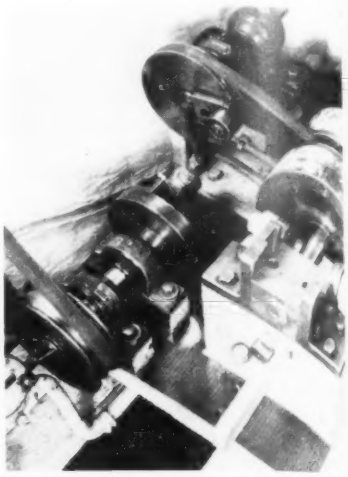

Figure 6. *The test machine developed to oscillate the outer ring of an anti-friction bearing.*

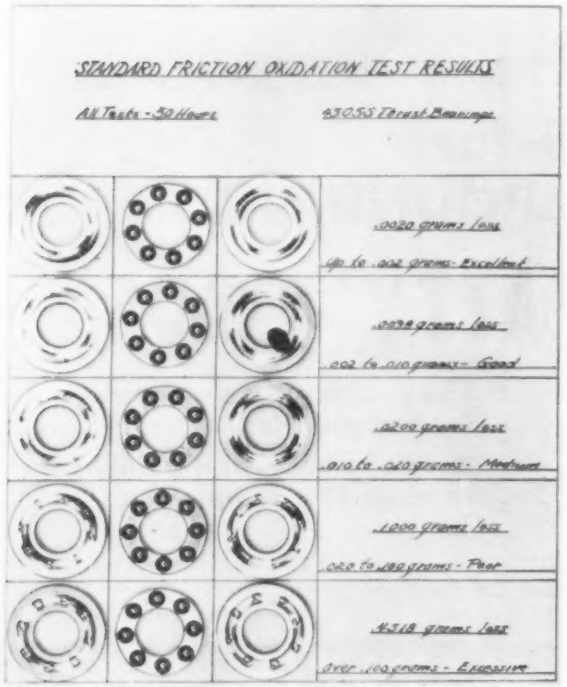
STANDARD FRICTION OXIDATION TEST RESULTS
All Tests - 50 Hours
43055 Thrust Bearings
.0020 grams loss
up to .002 grams - Excellent
.0024 grams loss
.002 to .010 grams - Good
.0200 grams loss
.010 to .020 grams - Medium
.1200 grams loss
.020 to .100 grams - Poor
.4318 grams loss
over .100 grams - Excessive

Figure 5. *Typical variations in friction oxidation effects using various lubricants under the same conditions of load, speed and time. Note the progressive variation from slight oxidation smears on the race surfaces of the first set of test washers to deep wear pockets in the races of the lower sets.*

CHART 1

Angle of motion (Degrees) of driving ring (Either inner or outer) to move a ball through an angle just sufficient so that a spot on the ball progresses from one race to the other.

Metric Sizes

Bore m.m.	200K	300K	400K	200W	300W	100W	900
10	108½	127	.....	.....	.....		102½
12	105	114¾	.....	.....	.....	.....	91
15	97¾	121¾	.....	97¾	.....		78
17	96¼	106	.....	.....	117½	129	67
20	90½	102½	.....	100½	112½	123¾	77
25	77½	106½	135½	86	106½	153	67½
30	85	103	114½	85	103	127	62¾
35	84¼	95½	121½	84¼	95½	121½	73½
40	80	93½	107	80	93½	117	67
45	73	92	109	73	92	109	73½
50	67½	91	110½	67½	91	110½	49¾
55	68½	90	108	68½	90	108	52¾
60	69½	89	73	69½	89	73	38¾
65	.....	88½	110½	70½	88½	110½	45¾
70	66½	87¾	109	66½	87¾	109	48¾
75	63	87¼	.....	63	93	112¾	47¾
80	.....	.....	.....	64¼	92¼	111	48¼
85	.....	91½	.....	65¼	91½	109¼	46
90	66	91	.....	66	91	110½	48
95	.....	.....	.....	67	90¼	103½	46
100	.....	.....	.....	67½	92½	104½	41
105	.....	.....	.....	68	92		46
110	.....	.....	.....	68½	90		44½

Aircraft and Small Metric Sizes

KP		KPA		KPB		30	
K3L	122	KP3A	122	KP21B	40½	33-3	96
KP3	99½	KP4A	96	KP23B	37½		
KP4	105½	KP5A	84¼	KP25B	35¼	33-5	136
KP5	128¼	KP6A	75	KP29B	31	34	127
KP6	123½	KP8A	72	KP33B	27¼	35	102½
KP8	125½	KP10A	82¾	KP37B	25¼		
KP10	115¼	KP12A	74	KP47B	24¾	37	106½
		KP16A	61¾	KP49B	25½	38	102½
		KP20A	52½			39	105¼

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by J. R. CORBET, President N.L.G.I.

LUBRI-MANIA

The North American Indian was an inventive chap. Possessing a horse, but no wagon, he conquered the difficulty of hauling his belongings about by the simple expedient of placing them upon two poles lashed together with leather thongs, and hitching one end of this home-made contraption to a horse, he let the other end drag the ground. The horse had been bequeathed him by some thoughtful Spaniard who was then attending an unscheduled ceremony in the Happy Hunting Grounds.

This crude outfit solved the problem of carrying heavy loads over the rough country side; it also solved the problem of toting more stuff a greater distance with less effort on his part. True enough, riding the squaw and kids on this vehicle was a rough and dusty ride, to say nothing of the fact that a day's journey probably wore the poles down to where his worldly possessions were skimming the surface of the earth.

How to correct the deteriorating effect of bumps, dust and excessive friction on this invention were, to this man, an insoluble problem. For him the nearest auto court and service station was 300 years away.

His modern counter-part fundamentally has changed very little. For locomotion he still depends upon a frame about the shape of his predecessor's, two poles complete with cross bars and lashings. For propulsion he has exchanged the horse for a gasoline motor. A vast improvement has been made by using wheels instead of two poles wearing themselves out dragging the ground. This addition of wheels was probably the biggest improvement achieved by modern locomotion over the Indian's idea on the same subject. Wheels reduce bumps, wear out slowly, carry more weight, travel faster and, above all, reduce friction to a minimum. Actually modern highway speed, safety and comfort is largely due to the reduction of friction through the use of wheels over two dragging poles.

So far as the modern motorist is concerned, his development stopped at this point. Of course he travels faster, more comfortably and certainly more dangerously than his primitive predecessors. Where his thinking and theirs meet in perfect accord, accompanied by the growling of wood over gravel and the shriek of outraged neglected metal scraping together, is on the subject of lubrication. The Indian paid no attention to this absorbing subject because he had no reason to; and the modern pale face too often leaves the subject to just plain luck so long as his car hangs together. For that matter his knowledge and interest in correct lubrication just about parallels that of a group of school boys who have just poured water on their mud slide that dips into the old swimming hole.

Take a good look at the front end of your car. Never mind the paint job, it can neither keep you from the hospital nor deprive you of a one way ticket to a permanent berth in your favorite cemetery. But the stuff located a few feet under it can, and frequently does.

I am not speaking of mechanical failures located there, but of your own personal failure to keep the workings in perfect condition so that they can operate as a servant obeying your slightest whim, and not as a judge who can pronounce a sentence that will send you to a wheel chair for life, or command you to suffer death itself.

All of this mechanism under that splendid paint job was built by the manufacturer to transport you swiftly and safely, provided you lubricate it correctly and regularly. Neglect it, and you will soon have hard steering accompanied by the usual sound of distressed steel squeaking, groaning and rattling for lack of life saving lubricants. Undoubtedly you have often felt the effects of extreme irritation and fatigue resulting from this mechanical discord. Think back and you will probably agree that hard steering to the accompaniment of squeaks and rattles has put you on edge to such an extent that you have narrowly averted an accident. These noises all too frequently have distracted your attention sufficiently that you notice them and not the road unrolling toward you at seventy miles an hour.

Remember when your car was new? How quickly and easily it responded to your touch. That time you pulled out to pass the car in front at a seventy-five mile clip; and then saw a transport truck bearing down on you from the opposite direction. You saw it in a split second just in time to flick the steering wheel and soar back into the lane again. It was a close shave, but you know now after driving your car only 35,000 miles, that you couldn't do it again if your life depended upon it—and it probably does.

"Mechanical failure, stuff isn't what it used to be, wears out after driving only 35,000 miles—why that front end driving mechanism should'a lasted 100,000 miles", you say.

In this case you are right about it being worn and should have lasted 100,000 miles of safe driving. The point you have just missed is the fact that there is no failure, other than your own to lubricate this mechanism every thousand miles. Any car whose steering and front end assembly is correctly lubricated at these intervals will faithfully and safely serve you without rapid wear of king pins, bushings and knee action assembly. Failure to follow this simple lubrication rule can easily cause shimmy and pulling to the right or left. This results in hard steering and needless tire wear because of excessive front end action.

Suppose you happen to be a slow driver or not particularly interested in an easy response from the front end. You are satisfied to wear yourself out tugging at a recalcitrant steering wheel during the course of a ten hour day while vacationing. Again your failure to follow this simple lubrication rule has resulted in your shoulders feeling as though you had been running a jack ham-

er all da instead of enjoying the scenery, your car and vacation.

The subject of shock absorbers nd their care in relation to safe iving seems to be a back alley sub- ct and not fit for polite conver- tion around a service station. Sel- om is even a whisper of a sugges- on made to lubricate them. Yet, ey are quite simple to service. The rrent attitude appears to be to let em wear out and then buy a new et.

In the meantime while a prospec- ve customer is being developed for new set, several types of expensive avoc are being relayed to the car nd its driver. Worn shock absor- ers result in an exaggerated up and own motion in the front part of the ar. Although the driver has the ex- lerating experience of forward mo- on as well as a teeter-totter move- ent reminiscent of his childhood, uch motion can result in losing con- ol of the car to say nothing of ex- ensive wear on tires. It costs very ttle to look after these safe guards o sane driving, but such attention an pay excellent dividends in the orm of a whole body and longer ife.

Possibly the reason most of us pay so much attention to the outward appearance of our car and so little thought to the hidden elements so vital to our comfort and safety is because they can't be seen. A new paint job on an old car, or better yet, a brand new car, adds social prestige and the comfortable feeling we are keeping up with the Jones'es. A badly needed lubrication job has never been known to put anyone into the country club set, or the social register. On the other hand, correct lubrication can do much in adding to the life of a car, to say nothing of its occupants.

For example, consider the well hidden brake cam shaft. Failure of proper lubrication can easily result in freezing with the car going into a side skid or side swipe accident. More than one family has been scattered over the local scenery because the car owner thought if this piece of mechanism couldn't be seen, it therefore needed no attention. The thousand mile rule does wonders in averting such memorable events.

"Well", you ask, "If I lubricate my car every thousand miles, is that all that is necessary?" Sorry, but the answer is an emphatic "No" to that question. There is the furthur element of what lubrication engineers call "Correct Lubrication". By this they mean using the proper lubricant in correct amounts through approved methods of application.

There is a good example of "Correct Lubrication" in the front wheel bearings of your car. They can soon show extreme wear through neglect to lubricate them with a lubricant made for this job and then properly applied. Once this wear has set in, you will notice an excessive amount of motion of the front wheels on the steering spindles resulting in loss of easy steering responses. Almost everyone has experienced the result of the wrong lubricant being incorrectly applied in too large an amount to these bearings. The excess soon flows into the front wheel brakes with—you know what results.

Too many of us are short of friends who applied their brakes on a highway curve just after having their front wheel bearings incorrectly lubricated.

If speaking of shock absorbers is not good service station etiquet;

(Continued on page 25)

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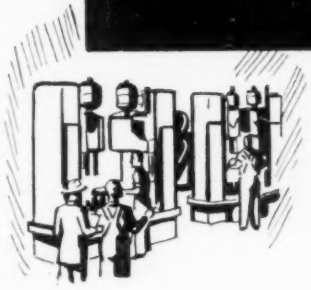

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SHORTAGES, OR UNPRECEDENTED DEMAND

(Continued from page 17)

depreciation to be based on replacement costs rather than on actual costs which no longer represent replacement values. If this were permitted, lower earnings would be reported because of the higher depreciation changes and depreciation reserves would be nearly adequate to cover replacements. Income taxes would be somewhat reduced and more money would be available to be put back into business to purchase new equipment to meet the constantly growing demands for petroleum products.

Under present conditions it is difficult to justify large expenditures at present high prices for additional facilities, providing one feels that similar equipment might be built at a later date for less money. On the other hand, because of the present political attitude toward the oil business, some oil companies feel it wise to go ahead with the construction of additional facilities even at the present high costs, in order to avoid further criticism and possible Government control of one form or another.

The fortitude of the petroleum industry, in going ahead with expansion plans at present prices, deserves the hearty commendation of both the Government and the public, but there seems to be little chance of the industry securing such approval under existing circumstances unless it can adequately present its story to a sympathetic public.

STATE AND FEDERAL GASOLINE TAXATION

State Gasoline Taxes

1919	$ 1,022,514.00
1927	258,838,813.00
1937	761,998,000.00
1947	1,199,718,000.00

Federal Gasoline Tax

1932 (6Mos.)	$ 62,839,826.70
1937	203,025,379.73
1947	455,350,120.23
1947 Federal Tax on Lubricating Oil	$ 78,649,309.01
Pipe Lines	18,029,960.00
1947 Total	552,029,389.84

First State Gasoline Taxes

Oregon	February, 1919 (1)
New Mexico	March, 1919 (1c)
Colorado	April, 1919 (1 to 2c)

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Iran
Iraq
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Bolivia
Brazil
Columbia
Ecuador
Peru
Trinidad
Venezuela

Africa:
Egypt

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Burma
India
China
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Japan
Netherlands Indies
Sakhalin

Australia—New Zealand

TOTAL, 40 Individual Countries

*Source: **World Oil**, Sec. 2 (Atlas), July 1948.

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FRICTION OXIDATION

(Continued from page 18)

AN-G-25 Low-High Temperature greases have been studied in both test machines. Results were not as good as AN-G-3a greases but are acceptable for aircraft specification requirements.

Silicone greases have also been tested but results were not satisfactory at room temperature.

Conclusions:

When bearings are required for oscillating use, certain precautions should be followed which may be summed up as follows:

1. Loads should be reduced at least to 50% and preferably below 35% of catalog tables using rpm column representing 0.5 times reversals per minute.
2. If possible, the total movement of the bearing should be sufficient to turn the balls 180°. (See Chart 1).

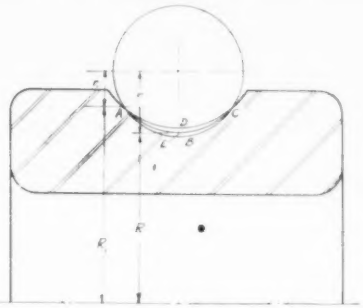

Figure 8. *COMPRESSION OF BALL AND RACE UNDER LOAD. Ball surface ABC is compressed by load to position AEC while race surface ADC is also compressed to AEC. R_1 is greater than R and r_1 is less than r, so skidding occurs at A and C.*

3. Lubricants should be selected for low temperature grease.
4. Seals and enclosures should be sufficient to keep the balls and contact areas submerged in lubricant.
5. Bearing looseness and machine vibrations should be at a minimum.

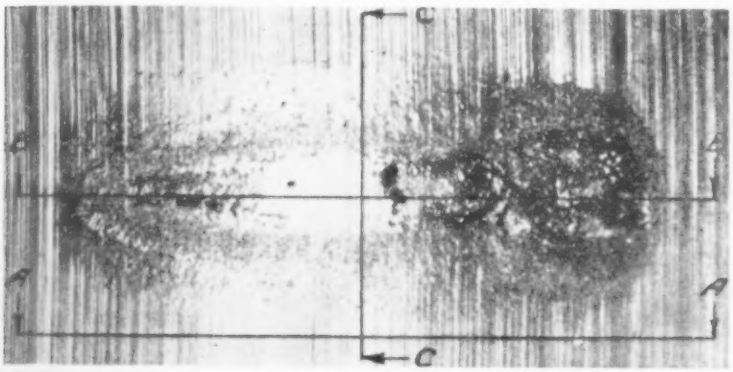

Figure 9. *Failure of races around the area of contact with the balls due to decomposition of the lubricant and resultant oxidation of the metal surface.* (Photo by J. O. Almen).

The following lubricants are preferred with the best ones listed first:

Ball bearing grease with finely divided zinc oxide filler.

AN-G-3a Lithium soap low temperature grease.

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(See page 26 for figure 10 and 11)

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LUBRI-MANIA

(Continued from page 21)

checking the brake fluid in the master cylinder seems to be accepted practice. After checking, it is the usual custom in proceeding to fill the cylinder without any previous knowledge as to the kind of fluid that is in the system. Actually, the attendant should report the lack of fluid with the suggestion the car be taken to the dealer. Checking is commendable, anything beyond that can easily be reprehensible.

There is another piece of mechanism in your car that is in the open and therefore seems to get too much of the wrong lubricant at the wrong time. This gadget is the generator. Upon this one item we all seem to vent our mechanical skill with generous doses of invariably the wrong lubricant. In a vindictive and wholly unaccountable manner it proceeds to retaliate by refusing to work and permitting the battery to run down. Never in the history of automotive history has this event been known to occur on anything but a dark and stormy night miles from home with every service station closed. Limping home with lights dimmed, or off, is a hazardous operation for those hardy souls who love to take a chance. People have been known to arrive home in one piece after such an undertaking. Others have tried it, and—well they are not talking.

What really happened was, that improper lubricant was applied in too large an amount with the excess dripping down onto the commutator causing dirt to accumulate. A dirty commutator is a temperamental object that usually refuses to work unless clean. From this little story about the stubborn commutator, you can easily see what is meant by "Correct Lubrication". Violate this rule and you will have trouble on your hands.

(Continued on page 27)

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FRICTION OXIDATION (Continued from page 23)

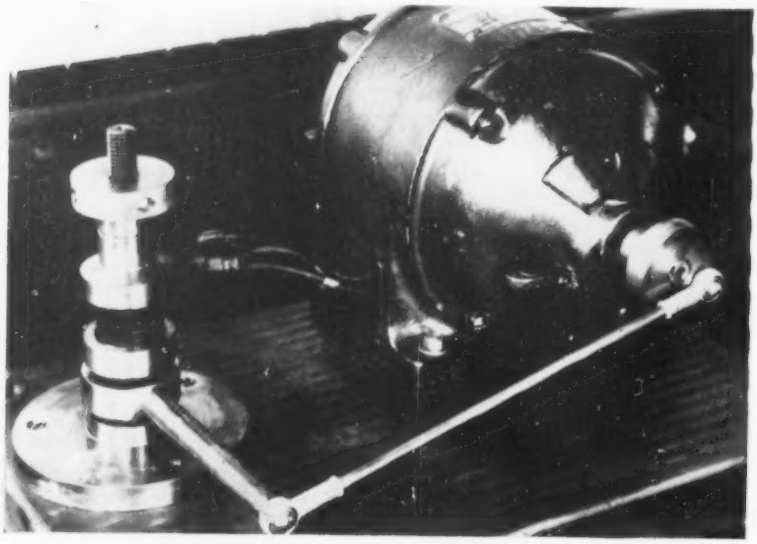

Figure 10. *A test machine to evaluate lubricants. It is shown here at rest.*

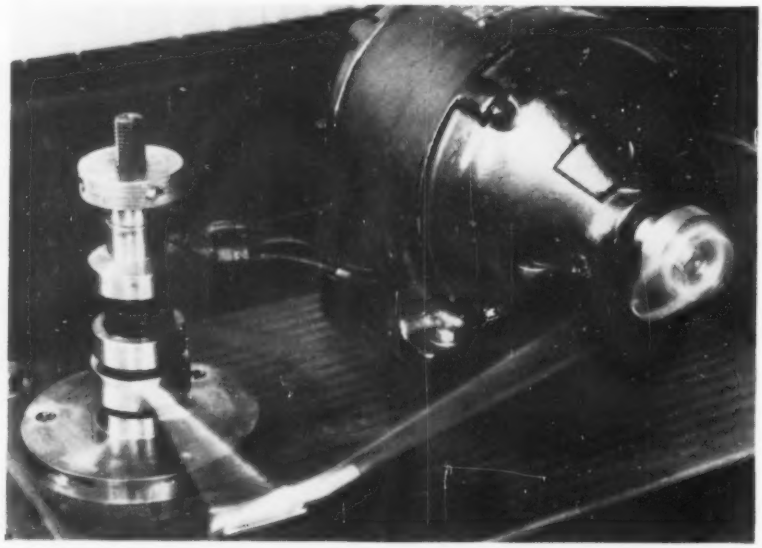

Figure 11. *The same machine in Figure 10 in motion.*

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UBRI-M. NIA

(Cont ued from page 25)

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This mania has taken the form of ieving that any mechanical failure entirely due to poor construction. a brake grab, a spring give way the steering mechanism fail to rk and we all chorus "mechanical lure". More than one motorist has en scraped off the highway by an bulance crew to the lament of, echanical failure", when the only lure was his own. His refusal to excessive wear through neglect- to properly lubricate at 1,000 e intervals has finally ended in all too frequent manner.

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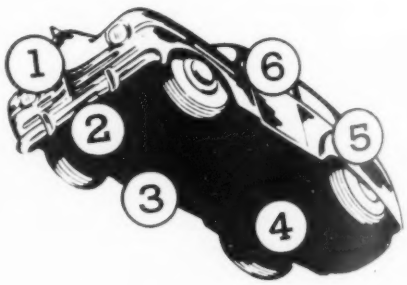

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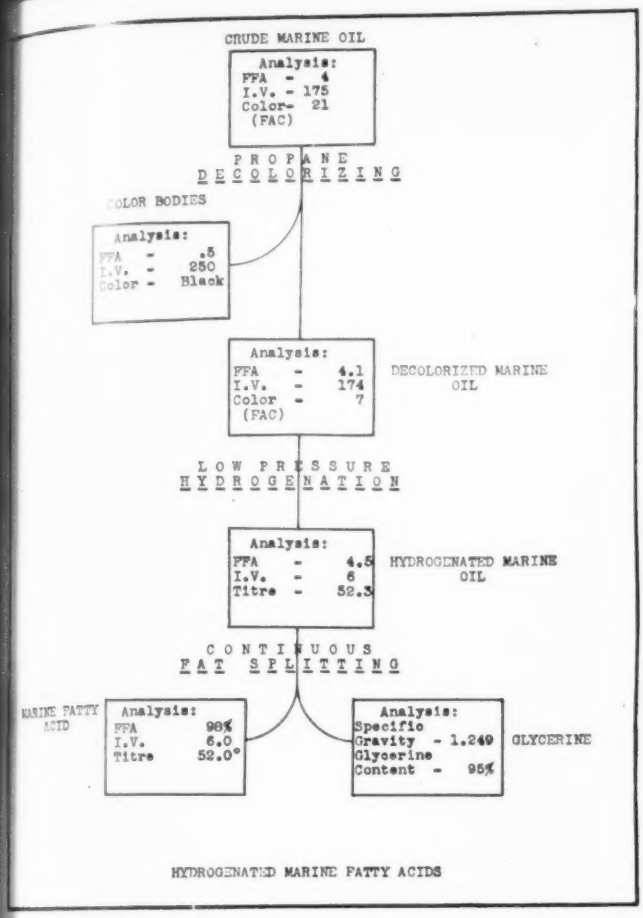
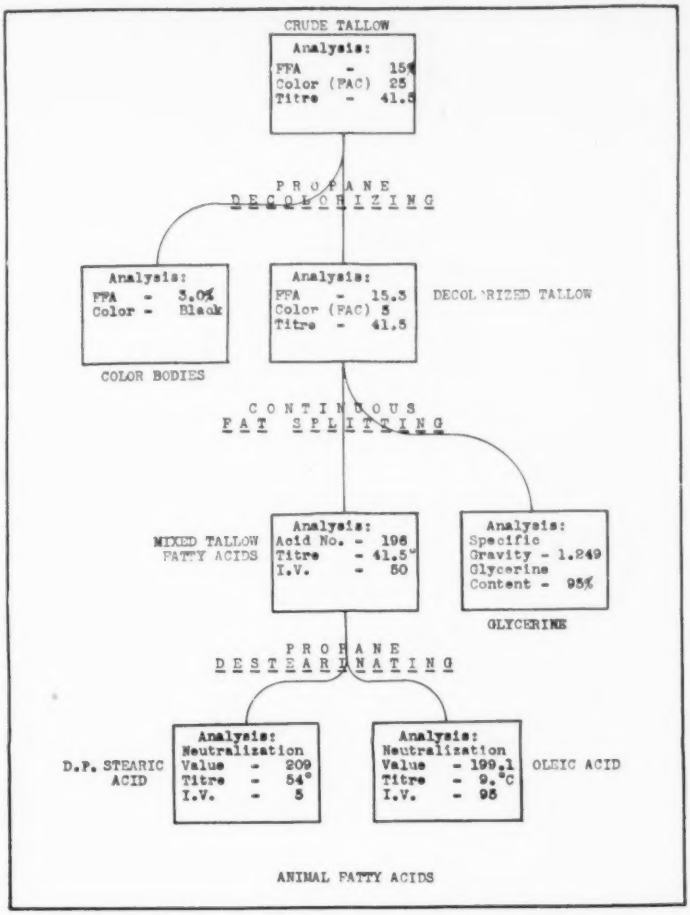




FATS AND FATTY ACIDS

(*Continued from page 6*)

other fractionated fatty products of high uniformity can be obtained for widespread uses.

The same quality control system used on many of Swift's present products will apply to the industrial oil program. This system consists of three main steps.

1. Specifications for each product are drawn up by the research laboratories in conjunction with the production and sales departments. These specifications are based on the needs of the customer.
2. Every batch of product is tested by the product control division of the research laboratories before it is approved for shipment. The test results must match with the original specification.
3. Batches that do not conform with these specifications are returned for reprocessing or set aside for disposal.

To assure production of high quality products, the plant at Hammond will employ almost as many chemists and chemical engineers as operating personnel. A pilot plant will be operated at the plant and a research staff will work continually to develop new products, improve existing products, and discover new uses for these products.

Sales representatives in the field will be men who are trained in the chemistry and production of industrial oils. One of their chief functions will be to discuss with the customer his problems and needs and to relay this information to the research, production and sales staffs. Thus by the work of this team grease manufacturers and in turn grease users will be supplied with products of maximum usefulness to their work. A partial list of these products appear in Table I.

REFINERS
MARKETERS GASOLINE DEEP-ROCK MOTOR OILS PRODUCERS
DEEP ROCK OIL CORPORATION
155 NORTH CLARK STREET CHICAGO 90, ILLINOIS

Foote
MINERAL COMPANY
A Step Ahead in Industrial Ores and Chemicals
PHILADELPHIA ASBESTOS • EATON • PENNSYLVANIA
HOME OFFICE: 1609 SUMMER STREET, PHILADELPHIA, PA.

VULCAN STAMPING & MANUFACTURING CO.
Steel Shipping Containers
BELLWOOD, ILLINOIS

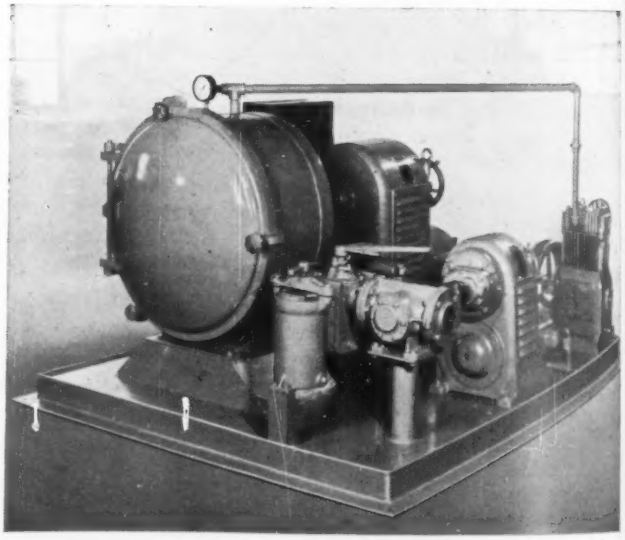
MANUFACTURERS OF
Fine Lubricating Oils and Greases
for all Automotive and Industrial Applications
SINCLAIR
SINCLAIR REFINING COMPANY
630 Fifth Avenue, New York 20, N. Y.

America's Finest Greases are processed by this machine

The nation's leading grease manufacturers are processing with the Cornell Machine because of its exclusive micro-film method, which reduces even the heaviest greases to an extremely thin film moving over a rotating disc with great velocity and tremendous turbulence. The result is a supremely smooth, thoroughly worked product which is completely de-aerated. The processing is done at a rate up to 210 pounds per minute.

Write for details of installation

THE CORNELL MACHINE COMPANY
101 PARK AVENUE, NEW YORK 17, N. Y.



Grease Homogenizer, showing feed pumps, strainers and vacuum pump.

THE CORNELL MACHINE
For Processing Lubricating Oils and Greases

Associate Members of the

NATIONAL LUBRICATING GREASE INSTITUTE

LISTED BELOW ARE THE SUPPLIERS OF YOUR INDUSTRY WHO ARE SUPPORTING YOUR ORGANIZATION THROUGH MEMBERSHIP IN THE N. L. G. I.

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

Armour & Co., Chemical Division
1355 West 31st St.
Chicago 9, Illinois
Member—Dale V. Stingley

American Cyanamid Company
30 Rockefeller Plaza
New York, New York
Member—A. Scharwachter

Ferro Chemical Corporation
Forbes Road
Bedford, Ohio
Member—S. B. Elliott

Foote Mineral Company
10 Chelton Street
Philadelphia 44, Pennsylvania
Member—H. C. Meyer, Jr.

A. Gross & Company
295 Madison Avenue
New York City 17, New York
Member—Eugene Adams

W. C. Hardesty Co., Inc.
41 East 42nd St
New York City, New York
Member—W. G. McLeod

Harshaw Chemical Company
1945 East 97th Street
Cleveland 6, Ohio
Member—A. D. Perry

Mallinckrodt Chemical Works
Second and Mallinckrodt Streets
St. Louis 7, Missouri

Metasap Chemical Corporation
Harrison, New Jersey
Member—F. J. Licata

Monsanto Chemical Company
1700 Second Street
St. Louis 4, Missouri
Member—J. W. Nemcombe

National Lead Company
105 York Street
Brooklyn 1, New York
Member—Alexander Stewart

National Rosin Oil & Size Co.
1270 Avenue of the Americas
New York City, New York
Member—Richard Bender

M. W. Parsons, Imports & Plymouth Organic Labs., Inc.
59 Beekman Street
New York City 7, New York
Member—H. Bye

The Werner G. Smith Co.
(Division of Archer-Daniels-Midland Co.)
2191 West 110th Street
Cleveland 2, Ohio
Member—F. C. Haas

Witco Chemical Co.
295 Madison Ave.
New York City, New York
Member—Allen B. Craig, Jr.

CONTAINER MANUFACTURERS

Central Can Company, Inc.
2415 West 19th St.
Chicago, Illinois
Member—Henry Frazin

Continental Can Co.
1103 Waldheim Building
Kansas City 6, Missouri
Member—N. M. Potts

Geuder, Paeschke & Frey Co.
324 North Fifteenth Street
Milwaukee 3, Wisconsin
Member—Willard J. Flint

Inland Steel Container Company
6532 South Menard Avenue
Chicago 38, Illinois
Member—J. T. Gossit

J & L Steel Barrel Company
70 East 45th Street
New York City, New York
Member—Jerry Lyons

United States Steel Products Co.
30 Rockefeller Plaza
New York City 20, New York
Member—Wm. I. Hanrahan

Vulcan Stamping & Manufacturing Co.
300 Madison Street
Bellwood, Illinois
Member—Dale M. Harpold

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

The Aro Equipment Corporation
Bryon, Ohio
Member—J. E. Allen

Balcrank, Inc.
Disney near Marburg
Cincinnati 9, Ohio
Member—R. P. Field

The Farval Corporation
3249 East 80th Street
Cleveland, Ohio
Member—A. S. Jennings

The Fil-Rite Company
342 Lumber Exchange Building
Minneapolis, Minnesota
Member—Howard G. Hornibrook

Gray Company, Inc.
600 N. E. Eleventh Avenue
Minneapolis 13, Minnesota
Member—L. L. Gray

Lincoln Engineering Company
5730 Natural Bridge Avenue
St. Louis, Missouri
Member—Foster Holmes

Stewart-Warner Corp.
1826-1852 Diversey Parkway
Chicago, Illinois
Member—Walter Duncan

U. S. Air Compressor Company
5300 Harvard
Cleveland, Ohio
Member—F. J. Coughlin

LABORATORY EQUIPMENT & SUPPLIES

Precision Scientific Company
3737 Cortland Street
Chicago 47, Illinois
Member—Alexander I. Newman

SUPPLIERS OF EQUIPMENT FOR MANUFACTURING LUBRICATING GREASES

Buflovak Equipment Division of Blaw-Knox Company
1543 Fillmore Avenue
Buffalo 15, New York
Member—A. W. Johnson

Cornell Machine Company
101 Park Avenue
New York City 17, New York
Member—Mead Cornell

The Girdler Corp.
Louisville 1, Kentucky
Member—John E. Slaughter, Jr.

Stratford Engineering Corporation
1414 Dierks Building
Kansas City, Missouri
Member—J. A. Altshuler

MARKETING ORGANIZATIONS

Refiners Marketing Co., Ltd.
555 South Flower Street
Los Angeles 13, California
Member—T. F. Harms

Southwestern Petroleum Co.
P. O. Box 789
Fort Worth, Texas
Member—J. W. Shugart, Jr.

REFINERS

Calumet Refining Company
4323 Southwestern Blvd.
Chicago, Illinois
Member— H. E. Semerau

TECHNICAL & RESEARCH ORGANIZATIONS

Armour Research Foundation
35 West 33rd Street
Chicago 16, Illinois
Member—L. O. Paul

Mellon Institute of Industrial Research
University of Pittsburgh
Pittsburgh 13, Pennsylvania
Member—Malcomb Findlayson

Midwest Research Institute
4049 Pennsylvania
Kansas City 2, Missouri
Member—Harold Vagtborg

For information concerning any of the products sold by our ASSOCIATE MEMBERS—Write the N.L.G.I. Office.

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PRESSURE SOAP CONTACTORS AND OIL CIRCULATION HEATING SYSTEMS

Make

CALCIUM CUP GREASE IN 1¼ HOURS

Cut Costs---Increase Plant Production
Produce A More Uniform Product

Stratco Pressure Soap Contactors and Oil Circulation Heating Systems make possible the manufacture of calcium cup grease, from raw material to packaged product, at the rate of six batches in eight hours . . . soda fiber greases in 2½ hours.

Simplified laboratory control . . reduced manpower requirements . . increased production of a more uniform product result. The Stratco process has been fully tested and proved in commercial operation.

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PETROLEUM REFINING ENGINEERS

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